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ABSTRACT

This paper presents the notion of a "question episode," the smallest complete unit of computer- student interaction in computer assisted instruction, and describes such important elements as question types, student input, interpretation of student inputs, computer replies, and duration limits. Included are some guidelines to help determine the quality of question episodes found in computerized lessons. This resource for preservice and inservice teacher training suggests two study activities and lists one reference. (Author/CMV)

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Number 4e

The Illinois Series on Educational Application of Computers

THE QUESTION EPISODE--BUILDING BLOCK OF TEACHING WITH A COMPUTER

J.Richard Dennis

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To the Reader,

This is one of a series of documents prepared as resources for the preservice and inservice training of teachers. The general theme of all items in this series is "teaching with or about computers". The booklets are the collective work of a variety of staff and students (both present and former) of the College of Education, University of Illinois at Urbana-Champaign. The project generously was supported between 1977 and 1979 by a grant from the EXXON Education Foundation. All responsibility for the content of these documents rests with the authors and does not reflect necessarily the views of the EXXON Foundation. It was my extreme pleasure to direct this effort throughout.

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THE QUESTION EPISODE--BUILDING BLOCK OF TEACHING WITH A COMPUTER

Almost since time began, questioning has been one of the most important parts of teaching. Sometimes it is intended to motivate the learner, to tease him into a learning activity. Sometimes it is intended to assist the learner in discovering a new idea for himself, believing that the idea is a personal creation of the moment. Sometimes questioning is intended to determine whether or not learning has taken place.

The art of questioning has been one of a very few important attributes defining effective teaching. This is even more true of instruction controlled by a computer. One of the most valuable contributions that a computer can make to education is to make instruction and learning interactive. Too often in conventional schooling, students are passive. They are experiencing what we might call "intellectual down time." This frequently happens during lectures. It also easily can happen during reading activities when the eyes follow the words but the head is not attending to the meaning.

Even when students seemingly are active in learning, as they appear to be while doing exercises, another of the very few important attributes of effective teaching usually is missing. This is the attribute of feedback or knowledge of results. Several studies have shown that feedbck accompanying learner action is a very effective learning situation (not just action alone, but interaction). With properly designed computer programs, a computer system can create personal conversations between the author-teacher and each of the students who uses those materials.

On the other hand, computers need not be used this way. Computer-based instruction can be long sessions of information which the student is to read and absorb. Computer-based instruction also can be sets of exercises which each student executes, always in the same order. Computer-based instruction can be questions answered by the student, with knowledge of when one is answered incorrectly, but with no assistance as to why it is answered incorrectly nor how the student's thinking must change to answer correctly.

Instructional computing can be any of these undesirable forms. The determining factor is the skill at interaction of the human creating the materials the computer executes. A necessary first step in developing this skill is the development of a much broader understanding of questioning as it is present in good teaching.

In the English language, a question is an interrogative expression. For teaching with a computer this definition must be expanded. Probably in live teaching too, effectiveness is increased whenever questioning is thought of more broadly than as "interrogative expresssions." In the material that follows we shall define the notion of a question episode by describing in detail the ingredients of such an event. Included here will be some guidelines to help determine the quality of question episodes found in computerized lessons. Then in several later papers in this series, we shall discuss schemes of connecting question episodes together for various instructional purposes.

The Question Episode

For purposes of instruction with a computer we make the following defintion:

> The question episode is the smallest complete unit of computer-student interaction.

Immediately, we must elaborate on this definition by describing the components of this basic unit of interactive instructional computing. A question episode is composed of the following:

1. An interrogative expression (a question), perhaps accompanied by other statements.

2. An opportunity and a requirement for student input of information.

3. A means of computer interpretation of the student input.

4. A set of computer offered consequences, remarks, or replies specific to the student input.

5. A decision algorithm to establish the duration of the episode.

These are the ingredients of every question episode and we would argue that each of these elements carefully must be considered in each such episode of interactive instruction. Following is a more detailed discussion of each of these elements.

A Question

Generally speaking, teachers have had little exposure to good questions. In the typical sixteen years of preservice preparation, they probably have heard few such questions asked. Moreover, teacher education programs give little--if any--explicit attention to this skill. It is not surprising, therefore, that many teachers need help in developing awareness of and skill in good questioning. On the one hand, each question implies or suggests a particular type of response. On the other hand, each question attempts to elicit learning at a particular level, be it the knowledge (or fact) level, the understanding level, the application level, the thinking skill level, the attitude level, or so on (See Gronlund, 1976). Thus, one important characteristic of good questions is that the type of response implied or suggested should match the level of learning outcome for which the question is directed.

To look at this more closely, we should review the types of questions encountered in learning situations. These are:

1. Alternate response

2. Matching

3. Short Constructed (fill in the blanks, numerical, word or phrase)

4. Multiple choice

5. Interpretive

6. Essay

Immediately you will notice that the type of question is determined by the associated method of answering.

Alternative response (dichotomous choice) questions are most appropriate for determining recognition of one of two opposing positions such as true or false, yes or no, etc. In instructional computing, alternate response items are most useful as a means of giving student choices. For aiding learning, alternate response items tend to promote guessing and thus are very unreliable in terms of indicating that learning has occurred. They are best used for determining: 1) knowledge of truth/falsity, 2) ability to distinguish fact from opinion, and 3) discrimination between appropriate and inappropriate choices.

There are several means for improving alternate response questions. For one thing, a proper balance must be struck between triviality and obscurity. Keep sentence structures simple and avoid the use of multiple negations. This type of question should be avoided in situations involving generalizations because it is very difficult to word proper quantification in many cases. If using several such questions successively, avoid having the length of the question cue the correct answers. There also is a compound questioning technique which utilizes an alternative response item in conjunction with any of the types of items discussed above. In this technique a true-false, multiple-choice, short answer, essay (or whatever) item is linked with an item like:

How certain are you that you have answered the previous question correctly?

(a) Quite certain

(b) Not very certain

The computer forces the student to respond to this statement of

confidence regarding each item before it presents the student with knowledge of the correctness of his answer. Such questions are useful in classifying students as:

Knows, and knows he knows

Knows, but is uncertain

Knows not, and suspects it

Knows not, and is unaware

Matching style questions are most effective when the learning outcomes call for the identification of associations. This is the case in learning lists of events and dates, capitols and states, etc. Some of these lists are very important learnings to their subject as is the case of the various arithmetic facts and the chemical element names and symbols. The compact form of matching style questions permits the simultaneous treatment of a relatively large quantity of content.

In their more effective form, matching items contain homogeneous material. In a matching item, the possible responses of the student are made explicit, as are the involved cues or stimuli. Such items are improved if the list of stimuli and the list of responses are of different lengths. Also, it is a good idea to include more responses than there are stimuli, and to have some responses that fit more than one of the stimuli. This insures that the student remains attentive throughout the entire question. In the text of the question it is important to state some basis on which the matchings are to be made.

Short Answer questions are most appropriate when the learning outcomes are recall of facts, principles, methods, or the interpretation of data. Such items are used very often for problem solving activities in mathematics and science. For this type of question, the student must construct the answer, and report it. In a computerized environment this can raise special problems that must be solved or handled. Numerical equivalents must be equally acceptable unless some form of reporting the answer is explicit in the question. For verbal short answers, problems with spelling greatly can interfere with computer control of the situation.

There are a number of useful principles to employ when constructing short answer questions for computerization. It usually is a good idea to word them so that answers are brief, definite, and the alternate correct forms are few in number (highly defined and well delimited situations). If using short verbal answers, some means of recognizing misspellings must be present. It is better to construct the question from fresh

sentences than to use ones taken from texts or other materials. Direct questions usually are preferred over completion (blanks filling) types because direct questions are less likely to inadvertently cue the correct answer with grammar or sentence structure. For questions requiring a numerical answer, one should either specify the units (or form) to use in reporting the answer or prepare the computer to accept a variety of equivalent replies.

Multiple Choice items are, perhaps, one of the most widely used question types (partly due to their heavy application in testing). Also, with practice and training, teachers can learn to write good questions of this type to address a wide variety of learning outcomes, even some of the more complex ones. However, these items are not particularly good for problem solving situations since clever students quickly learn to answer by checking the plausibility of the choices rather than by constructing their answer. There is also the type of multiple-guess format in which the number of correct responses is variable. The student is to choose all correct completions of the stem (answers to a question) with the understanding that, given x choices, from 0 to x may be selected.

A multiple choice question is constructed of a statement or question (called the stem), and a list of alternatives that includes the answer and a number of distractors (or foils). Some questions of this type require selecting a correct answer and some require selecting a best answer. Although this type of question particularly is good for diagnosis of learning, it is one of the more difficult types to design. In a multiple choice item one wants all the distractors to be equally plausible. It usually is difficult to create three or four equally plausible incorrect answers. One way that teachers more skilled in question writing do this is to use a question first as a constructed response type. They keep lists of the incorrect responses and their frequency. After several uses of a question, it is recast as a multiple choice type, using the most frequent incorrect answers as foils. This usually results in a multiple choice question of reasonable quality. In constructing the stem of a multiple choice question, one must exercise care that the expression has meaning by itself, and that it is explicit on a problem. This means that, for example, one should avoid inserting irrelevant material, and should avoid negations since such can cause students to respond incorrectly simply out of logical confusion. Among the alternatives, there should be one clearly correct answer, and all of the choices should match the stem grammatically. Correct answers can be cued by inadvertent changes in gender, in tense or case of verbs, etc. Try to construct all the alternatives of about the same length, and when using several such questions in succession, change the position in the list of the correct answer. Finally, one should use phrases such as "all of the above" or "none of the above" very carefully. Too often, teachers fall into

patterns in which, for example, whenever "all of the above" is present in a question, it is the correct choice.

Another difficult question type to construct is the interpretive one. This type of question begins with an opening episode or scenario. This will contain a description of the question setting, and information or data about that setting. Following this there will be one or several demands of the student to recognize relevance of some of the information, to identify unwarranted generalizations, to apply a principle, to recognize assumptions or inferences, or to interpret experimental findings. This type of question is common in the social sciences.

With some practice, teachers can learn to write interpretive questions in multiple choice form. In this form such questions can be computerized easily and lend themselves to opportunities to individualize instruction. Aside from the difficulty of constructing such questions, the major disadvantage of interpretive questions is that they tend to demand better reading ability of the student. However with careful attention to vocabulary, complexity of sentences, and clarity and with careful editing, this type of question can be very useful.

Essay type questions are important to teaching in many situations because they provide access to many of the higher level learning outcomes such as organization, integration, or relation of ideas. This type of question offers the student the ultimate in terms of freedom to respond and therein lies the disadvantage for computerization. It is extremely difficult to build computer programs to interpret free-form responding in other than very limited contexts. Most such efforts to date have been on large educational computers (such as PLATO at the University of Illinois), or in artificial intelligence research laboratories. For these reasons, we shall not put emphasis on this type of question at this point in time except to say that 1) it is very important for teachers to know how to use essay type questions and 2) an instructional computing system will be of little help with such questions for some time to come.

Student Input

The second element of a question episode, as we have defined it here, is the opportunity and the requirement for the student to give an answer to the computer. Clearly, the form of this answer should match the form of the question being used, as discussed in the previous section. For efficient learning and also for efficient operation of an instructional computing system, the student must have been informed of the mechanics of presenting his answer.

The nature of the answer and its relationship to the characteristics of the student are important issues to consider. Lessons requiring relatively complicated use of keyboards, such as typing superscripts or subscripts, or complicated typing operations, should either be avoided or else should be preceded by other lessons deliberately designed to teach those answering skills.

Interpretation of Student Input

The input interpretation element of a question episode must have the following parts:

1. A means of recognizing a correct response and all reasonably synonymous answers.

2. A means of recognizing literally incorrect, but conceptually correct answers.

3. A means of recognizing an array of frequently occurring incorrect answers.

4. A means of recognizing undetermined, probably incorrect answers.

The ability of a question episode to interpret and classify student answers provides one of the measures of individualization. Particularly on constructed answer questions, there usually are many ways to answer a question correctly. Then there usually are several more ways to be "thinking correctly, but saying it wrong." Misspellings fall into this category. Then there is the distinction between an incorrect answer for which "I think I know why you answered that" and one for which "I haven't the faintest notion what you are thinking." The completeness and accuracy with which a question episode makes these distinctions in great measure influences the quality of that episode. In fact, we would argue, it is difficiencies in this respect among early attempts at instructional computing that have disenchanted many potential advocates of the medium.

Computer Replies

In a truely interactive instructional environment, more than just knowledge of correctness or incorrectness is appropriate. Much teaching can be included in the replies that are given when an answer is confirmed or denied. For computerized question episodes one needs at least the following:

1. Messages that confirm correct answers and reinforce reasons for this correctness.

2. Messages that confirm correct thinking when it is detected and facilitate construction of a literally correct answer.

3. Messages that deny predictable incorrect answers and give reasons for the incorrectness that will facilitate a remedy.

4. Messages that deny unidentifiable incorrect answers and suggest appropriate means of seeking help in remediating the situation.

Clearly this part of a question episode intimately is tied to the input interpretation provision of the episode. In good computerized instruction, one should go to great lengths to avoid: 1) a simple "no" to an alternate form of the correct answer, 2) a simple "no" to an incorrect answer with no hint of why it is incorrect, 3) an "OK" to answers that appear correct but may have been derived accidently under a misconception.

Duration Limit

Despite Herculean efforts at carefully designing corrective measures and individual responding, there are going to be occasional students who, for some question episodes, answer incorrectly time after time and the corrective measures do not alter the situation. The important decisions that the computer must be equipped to make in such cases are how long this situation is allowed to continue and how it is ended. Students who, for whatever unknown reason, believe their answer to be correct and so, continue giving it, while the computer continues to reject it, can become very frustrated and have their motivation and interest destroyed very quickly. What is needed in all question episodes is a means of limiting such "endless loops" when they occur. This can be a limit on the number of successive responses that are permitted. Beyond this, there needs to be careful attention to what the computer does when one of these situations occurs. The inability to answer correctly may prevent the student from

successfully going on to the next episode. It may be that he should go back through specific episodes to attempt to construct the knowledge that either is missing or was incorrectly constructed previously or it may be that the appropriate decision is to terminate the session at that point. The important point is that whenever a discontinuity of this type occurs in instruction, the teacher somehow should be informed of the details to the extent that they exist. This could be achieved by informing the student to consult the teacher with some form of record (paper copy, etc.) of his experiences. Another means of informing the teacher is through a data profile of the experience which could be put into a computer file on which the teacher consults and acts.

At this point in time, it is rare to find computer materials in which questioning takes place with this degree of detail. This is not because computers are incapable of doing these things but rather that this much attention to the design of materials is difficult and expensive for the humans to do it. However, for future large scale implementation of many materials in many subjects for many students, attention to these details will be necessary.

SUMMARY

This paper has presented a definition and a detailed description of the question episode. In the view of the author, this is the smallest, complete unit of interactive, instructional computing. Careful attention to the design and detail of question episodes accounts for a majority of the differences between good and not so good computer lessons. In computerized lessons students can be pushing keys, paying little attention, not very interested, and probably not learning very much. Such lessons can interact like a personal tutor, can be individualized and tailored to personal learning styles, and can maintain a high level of interest and motivation. The choice is left to the lesson designer.

STUDY ACTIVITIES

1. Select a current text book in your field and choose a list of study or homework questions from a page in the text. Critique the questions as to quality of the design and other attributes found in this paper.

2. Take a specific unit of a text with which you are familiar and attempt to design a question on the subject matter in each of the six types discussed. Keep in mind the suggestions offered in the discussion of each question type. Prepare a correct answer list for each of your questions and consider what other possible answers might a) be acceptable, b) show correct thinking but incorrect answers, or c) illustrate that the student definitely does not understand the material. For parts b and c suggest follow-up computer responses which might help the student understand why his or her answer is incorrect.

BIBLIOGRAPHY

Gronlund, Norman E., Measurement and Evaluation in Teaching (Third Edition), Macmillan Publishing Company, 1976.